# Death of the doughnut

*How quaggas are casting a pall on the Lake Michigan fishery*

*by Marcia Goodrich*

The Asian carp may be a scene stealer, leaping out of the Mississippi River like popcorn in a skillet, smacking boaters in the face, and starring in no end of slap-happy YouTube videos. But for sheer destructive might, this algae-eating invader can't hold a candle to a certain European mollusk about the size of a fat lima bean.

Michigan Tech biologist W. Charles Kerfoot got his first insights into the quagga mussel back in 2001, when he and his research team were checking on a huge, green ring dubbed "the doughnut" they'd discovered a few years earlier in southern Lake Michigan.

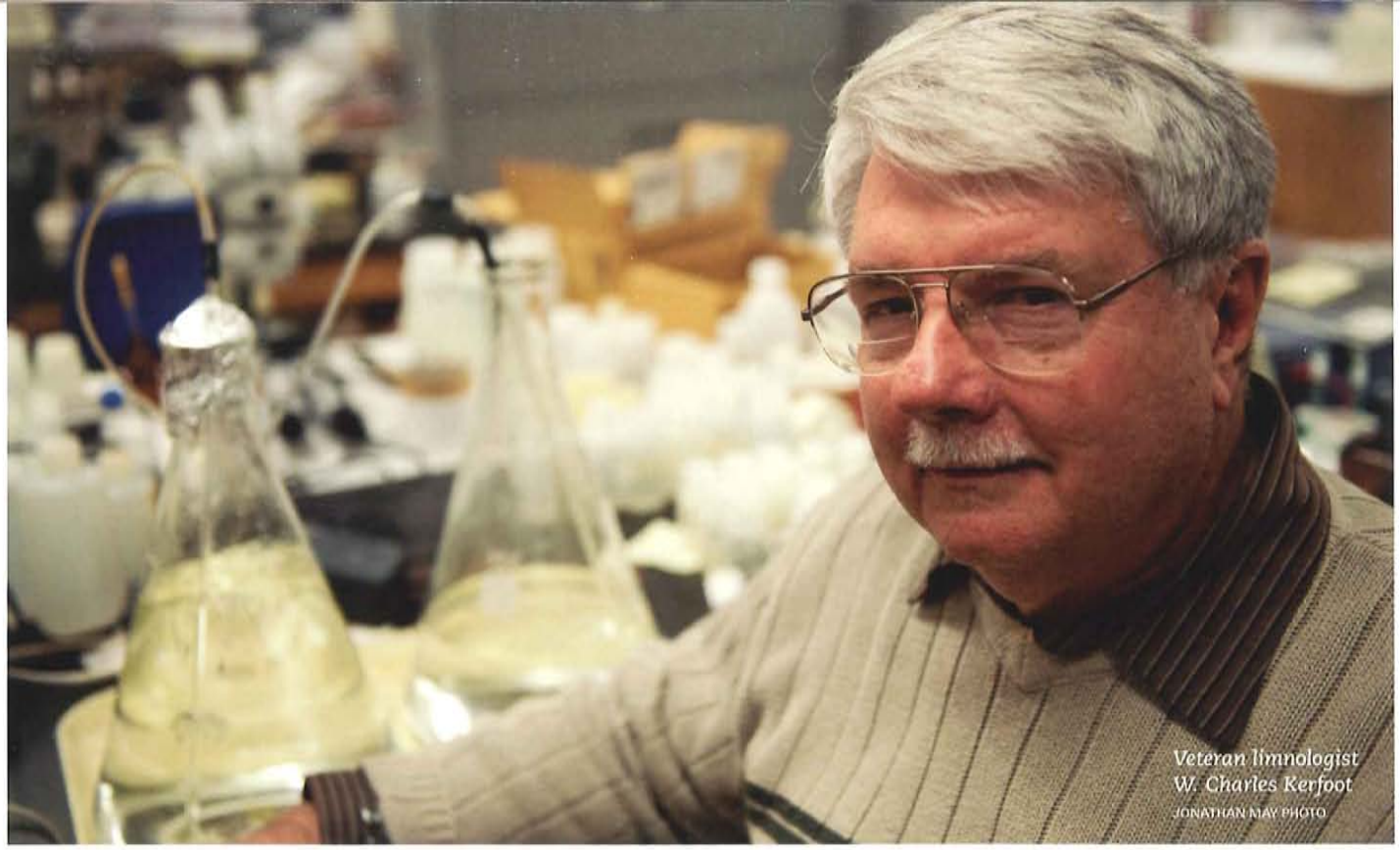
No one knew about the doughnut, much less the quagga, until Kerfoot and his research team first saw it in 1998. Using NASA's new Sea-viewing Wide Field-of-view Sensor (SeaWiFS) Project, they saw a roughly circular river of phytoplankton—algae and other tiny plants—that was drifting counterclockwise around the southern end of Lake Michigan, creating a doughnut.

The group determined that the doughnut was formed when big winter storms kicked up sediments along the southeastern shore of the lake. There, Michigan's biggest rivers drain a watershed rich in phosphorus and other nutrients from cities and farms. Those nutrients settle in the lake's sediments until storms stir them up. Then, suspended in the water column, they begin circulating in a slow-moving gyre that flows from Grand Haven in the north to Chicago in the south. That gyre creates a Thanksgiving feast for phytoplankton. "We saw that with each storm, you get a ring, and it can persist for weeks or even months," says Kerfoot.

"We were floating in the clouds, saying 'Hey, we discovered a new phenomenon,'" he remembers. Samples of lake water taken from research vessels verified the satellite data. Plus, they found that zooplankton, the tiny animals that feed on phytoplankton, were much more abundant in the doughnut. For them, the seasonal bloom was an all-you-can-eat salad bar, an important part of their strategy to survive winter. Those zooplankton were eaten in turn by small fish, which were eaten by large fish, which fueled an angling paradise productive enough to merit the nickname Lake Fishigan.

Then, almost as soon as it was discovered, the doughnut started to disappear. "Since 2001, the chlorophyll has been nibbled away on the edges, right where the quaggas are," says Kerfoot.

The quagga mussel has been found in all of the Great Lakes, in all likelihood introduced by ocean-going vessels when they dump their untreated ballast water. In addition to clinging to hard surfaces like the more famous zebra mussel, quaggas also burrow into soft lake bottoms, where they can be found in concentrations of 10,000 to 15,000 per square meter. Their favorite food is phytoplankton, and they have prodigious appetites. Hank Vanderploeg, a colleague of Kerfoot at the NOAA Great Lakes Research Laboratory, calculated that they can filter up to one third of the water column in a day in the band of water around the lake that's



Veteran limnologist W. Charles Kerfoot
JONATHAN MAY PHOTO

**"They say people are getting tired of hearing that the sky is falling. Now, when the sky really is falling, they aren't paying attention."**

between thirty and fifty meters deep. There, they are consuming five to seven times as much phytoplankton as is being produced. "No surprise that it's that area that's cleaning up the most," Kerfoot says.

Using SeaWiFS, graduate student Foad Yousef has plotted a 75 percent decline in chlorophyll *a*, a measure of phytoplankton abundance, from 2001 to 2008. "You are seeing a displacement of productivity from the water column to the benthic layer," Kerfoot says. "It's fascinating."

That means that all the energy in the phytoplankton, which once fed fish, is being sucked down to the bottom of the lake by quaggas, who then eject it in the form of pseudo feces—mussel poop. That can stimulate the growth of *Cladophora* algae, which die, decompose, and remove all the oxygen from the surrounding water, to ill effect. "When things go anaerobic, that kills off everything, including the quaggas, and creates conditions for botulism. We've had massive kills of fish-eating birds—loons, mergansers," says Kerfoot. "Isn't that bizarre? Who would have predicted that?"

Under such conditions, however, it is predictable that populations of zooplankton will decline, and following them, the alewives, chubs, Atlantic salmon, muskies, smelt, walleyes, perch, and the rest of the hundred or so species of fish that inhabit the southern part of Lake Michigan. "A high percent of the fish biomass could be lost in the next couple years," Kerfoot says. NOAA scientists have already documented declines in several species. "We have a system that's crashing."

Why, then, isn't somebody doing something? Kerfoot was wondering himself, so he asked the NOAA scientists who are charged with keeping their thumbs in the dike to protect the Great Lakes from invasive creatures like the quaggas. "I asked why they weren't swimming in money to do something about this," he says. "They say people are getting tired of hearing that the sky is falling. Now, when the sky really is falling, they aren't paying attention."

One exotic species Kerfoot isn't worried about is that Asian carp, which has all the Great Lakes states up in arms for fear that it will enter the water system via the Chicago Shipping Channel and destroy the fishery. Quaggas will have done that job before the hundred-pound bottom feeders can even get a toehold, he says. "By the time the carp get here, there won't be anything left for them to eat."

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**For more information**
**www.bio.mtu.edu/faculty/kerfoot.htm**

**To view an ABC Chicago feature on Kerfoot's work**
**techtube.mtu.edu/kerfoot**

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